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Stennis Space Center, MS 39529-5004



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Developing a 1:3,000,000 Arctic and Antarctic Regions Shoreline Using the WVS Plus

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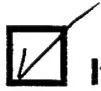
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<p>The National/Naval Ice Center (NIC) is currently involved in the creation of an Arctic Sea Ice Atlas for the Environmental Working Group (EWG) Arctic Climatology Project. The NIC is also responsible for creating near-real-time Arctic ice analysis products for various customers. The Naval Research Laboratory Geographic Information Systems (GIS) Lab has been tasked to assist in the EWG project by creating a shoreline for the Arctic and Antarctic Areas of Interest (AOI) defined by NIC. The creation of these shoreline data sets is in fulfillment of the deliverables of parts 3 and 7 in the Plan of Action and Milestones for the Development of a Spatial Data Transfer Specification Translation of EWG Sea Ice Data for the Naval/National Ice Center. The shorelines are to be used as products by the NIC for present and future operations.</p>			
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Developing a 1:3,000,000 Arctic and Antarctic Regions Shoreline Using the WVS Plus

1.0 Introduction/Background

The National/Naval Ice Center (NIC) is currently involved in the creation of an Arctic Sea Ice Atlas for the Environmental Working Group (EWG) Arctic Climatology Project. The NIC is also responsible for creating near real time Arctic ice analysis products for various customers. The Naval Research Laboratory Geographic Information Systems (GIS) Lab has been tasked to assist in the EWG project by creating a shoreline for the Arctic and Antarctic Areas of Interest (AOI) defined by NIC. The creation of these shoreline data sets is in fulfillment of the deliverables of parts 3 and 7 in the Plan of Action and Milestones for the Development of a Spatial Data Transfer Specification Translation of EWG Sea Ice Data for the Naval/National Ice Center. The shorelines are to be used as products by the NIC for present and future operations.

2.0 Approach

Currently, NIC is using the National Imagery and Mapping Agency (NIMA) World Vector Shoreline (WVS) standard data product in the Arc/Info® format as part of their Arctic Ice analysis products. The data set covers portions of the Arctic area north of 45 degrees latitude. In addition, NIC is developing an Antarctic ice product that requires a shoreline consistent in resolution with their Arctic shoreline. In 1996, NIMA produced a new version of its WVS product called WVSPLUS. The WVSPLUS database consists of several scales of global shoreline coverage in the Vector Product Format (VPF). The shoreline feature is derived from Digital Landmass Blanking data, supplemented by Operational navigation Charts (ONC), and Tactical Pilotage Charts (TPC).¹

The Naval Research Laboratory (NRL) GIS laboratory was tasked with clipping the WVSPLUS data into Arctic and Antarctic data sets using the Polar Stereographic projection. The geographic areas defined were as follows:

Arctic-	180E – 180W longitude
	90N – 34N latitude
Antarctic-	180E – 180W longitude
	90S – 50S latitude

In order for NRL to provide updated shorelines to NIC, a series of projections and data conversions were necessary. To meet these requirements, several basic guidelines of the shoreline needed to be outlined. The shoreline requirements are outlined below:

Projection: Polar Stereographic, North (+90) and South Pole (-90) origins, respectively.

Geographic area: Arctic Area, 90N to 34N and 180W to 180E. Antarctic Area, 90S to 50S and 180W to 180E.

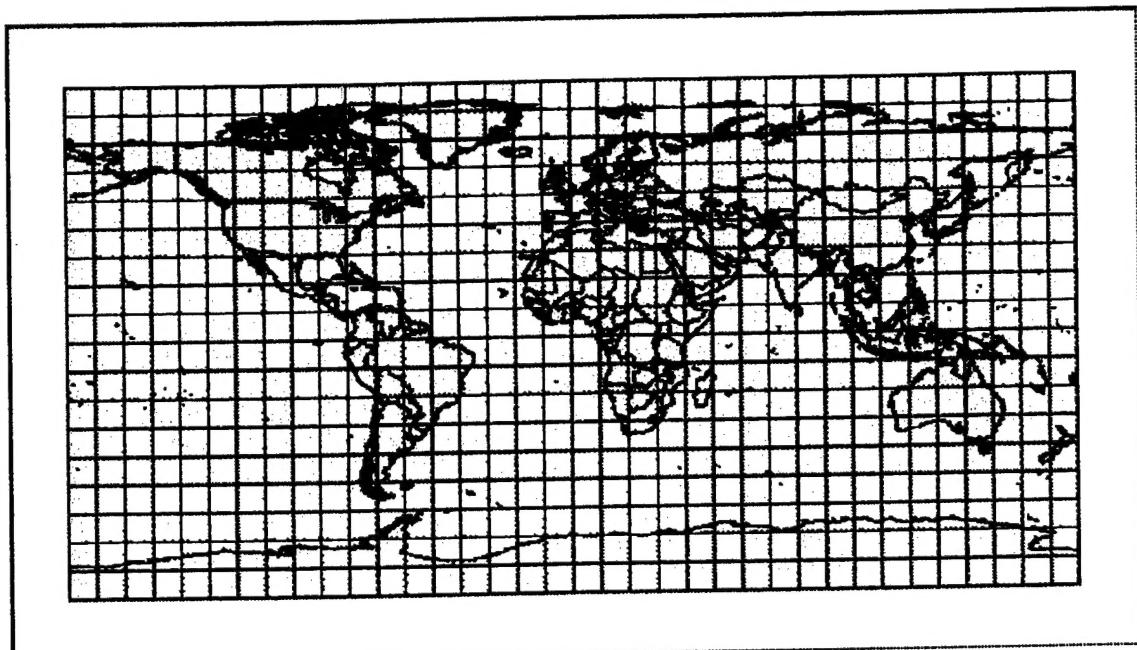
Data type: Polygon with full topology

Scale: That which corresponds to the final output of the NIC ice products.

Format: ARC/INFO coverages.

The software packages used to complete the shoreline conversion were Arc/Info® version 7.03 and Arc/View® version 3.0a. The process listed below outlines the major steps used by NRL to complete the shoreline transformation.

- 1) Format conversion: First, the WVSPLUS had to be imported and converted into a format usable by the Arc/Info® software. Arcview® 3.0 with the Vector Product Format (VPF) viewer extension was used to read the WVS data and convert it to the shapefile format. After the shapefile was built, it had to be converted to an Arc/Info polygon coverage. This step was necessary to clip and project the shoreline.

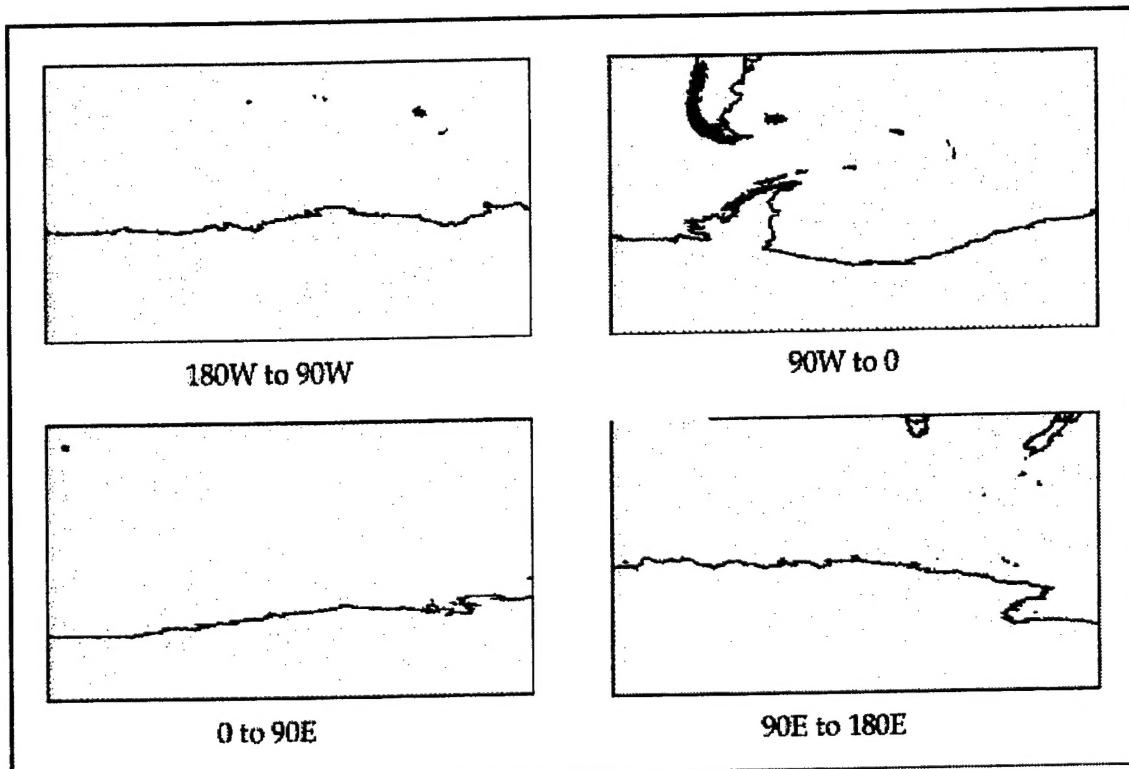


View 1 depicts the World Vector Shoreline before the AOIs are clipped.

- 2) Areas of Interest (AOI): The shorelines needed to be clipped to their respective AOIs before they were to be projected. The CLIP command was used to clip each of the two shorelines.

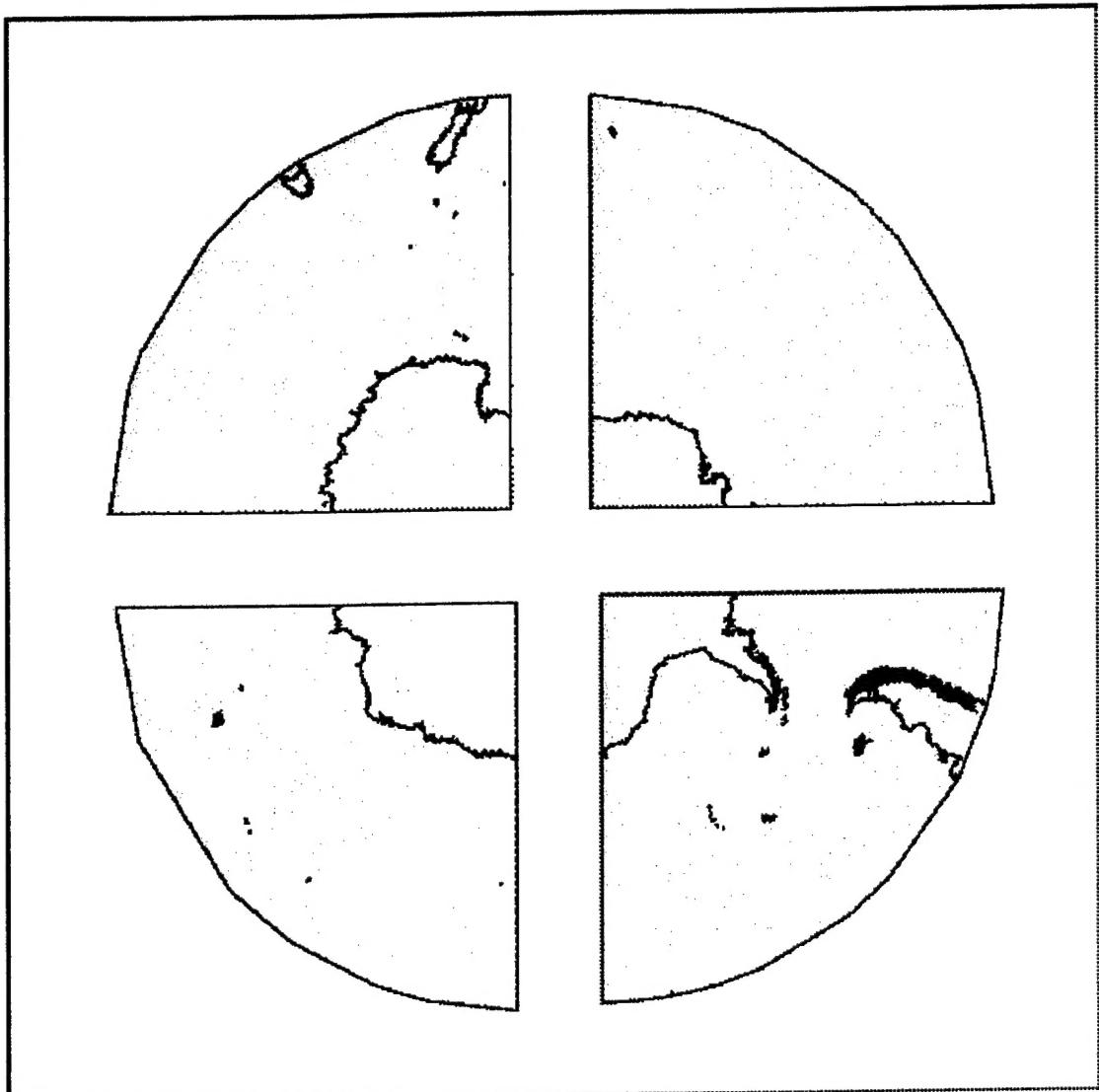
3) Dissolve: The WVSPLUS original shoreline product has tile boundaries included in the data set that needed to be removed. To remove the boundaries, the DISSOLVE command was used with the FACC code as the selected feature. The FACC code delineates the land/water boundaries of the data set. The remaining polygons in the coverage after the dissolve were the shoreline boundaries.

4) Clip and Project: Due to the large volume of data, the last step before the projection of the shorelines required the data be divided into 4 pieces again using the CLIP command. If they were not divided, the software would have problems projecting and rebuilding the data properly.



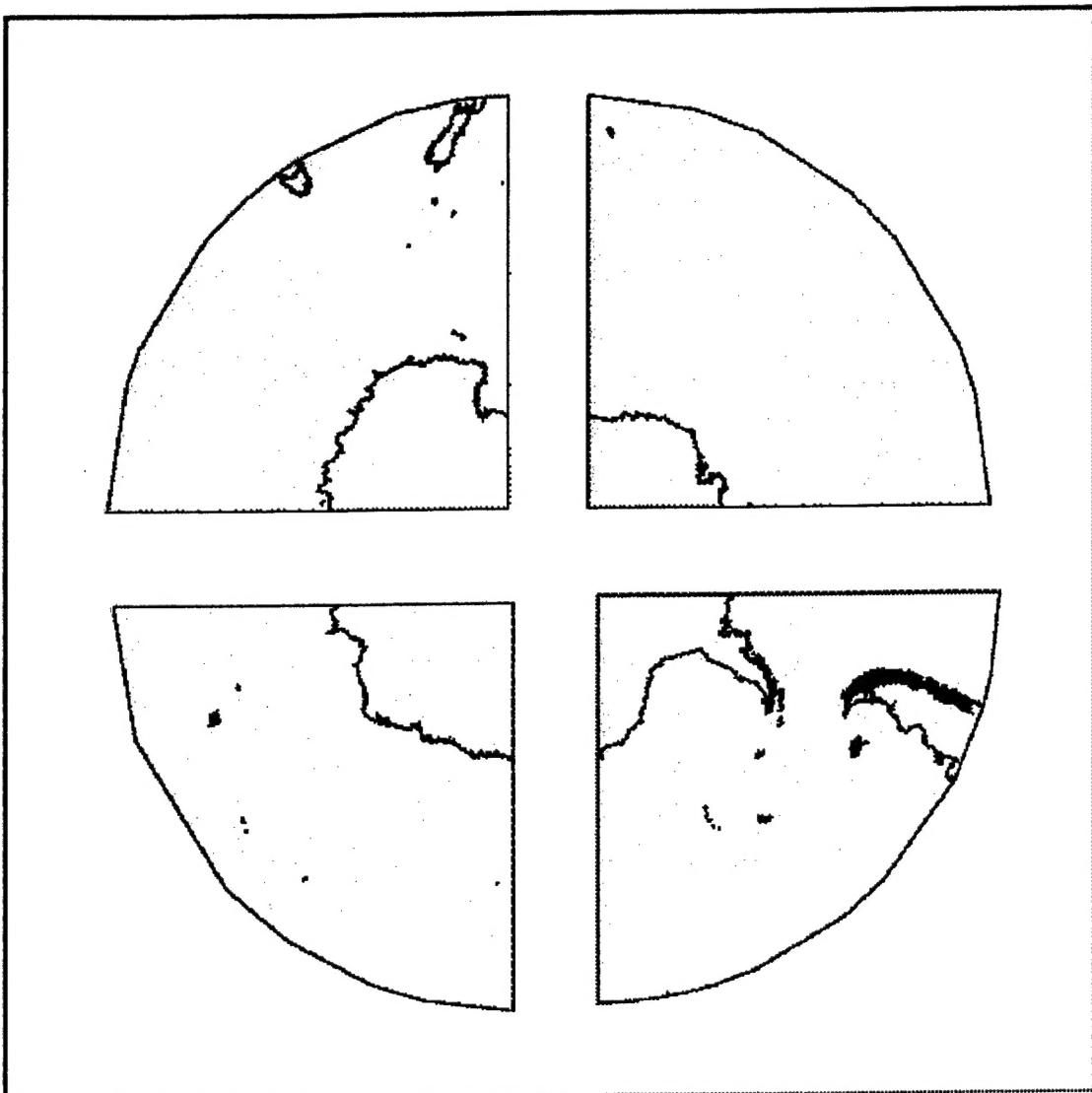
View 2 shows the Antarctic Area clipped into 4 quads before the projection.

Once the areas were divided, the Arc/Info® PROJECT command was used on each quad to transform the shoreline from geographic to Polar Stereographic. The projected shorelines were then built as lines to reassemble the coverage after the projection. Any lines broken during the projection process were then edited in order to repair any polygon topology. After the edits were completed, the line coverages were rebuilt with polygon topology.



View 3 illustrates the 4 quads of the Antarctic AOI after being projected and edited.

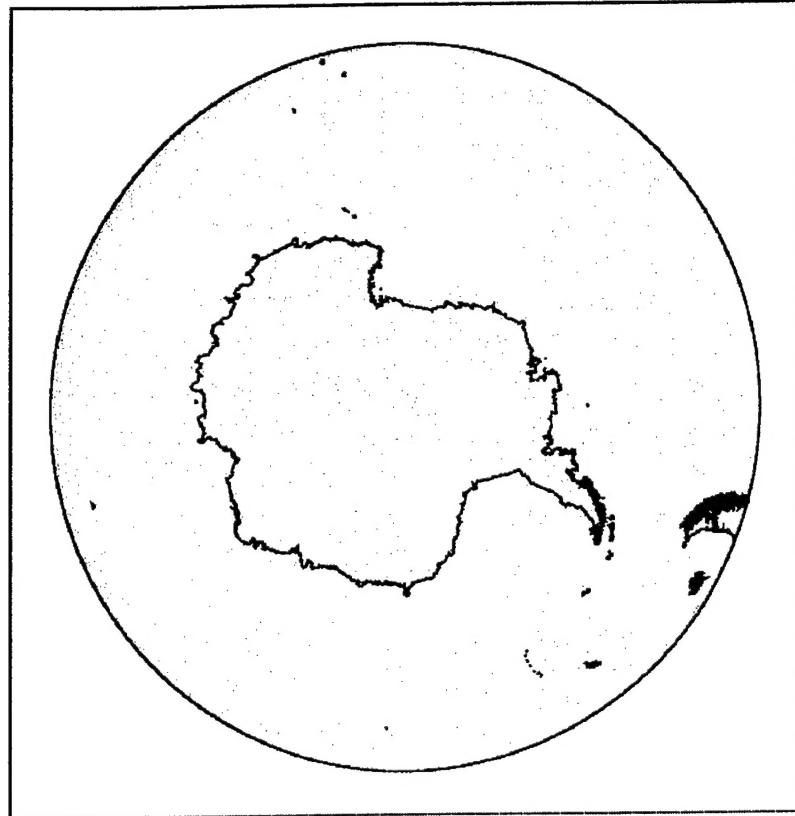
- 5) Edgematch: The corners of the 4 quads of each shoreline had to be edgematched in order for them to “fit” back together to properly form the full area coastlines. The EDGEMATCH command in ARCTOOLS® was used as an interactive process that allowed changes to be made manually or automatically to the quads of each AOI to coordinate them with adjacent polygon data sets.
- 6) Mapjoin: Once the 4 quads of each AOI were edgematched, the MAPJOIN command was used to combine them into single coverages encompassing the entire shoreline for each AOI. The mapjoin command does not remove boundary lines from the coverages during the process, so they had to be removed afterwards.



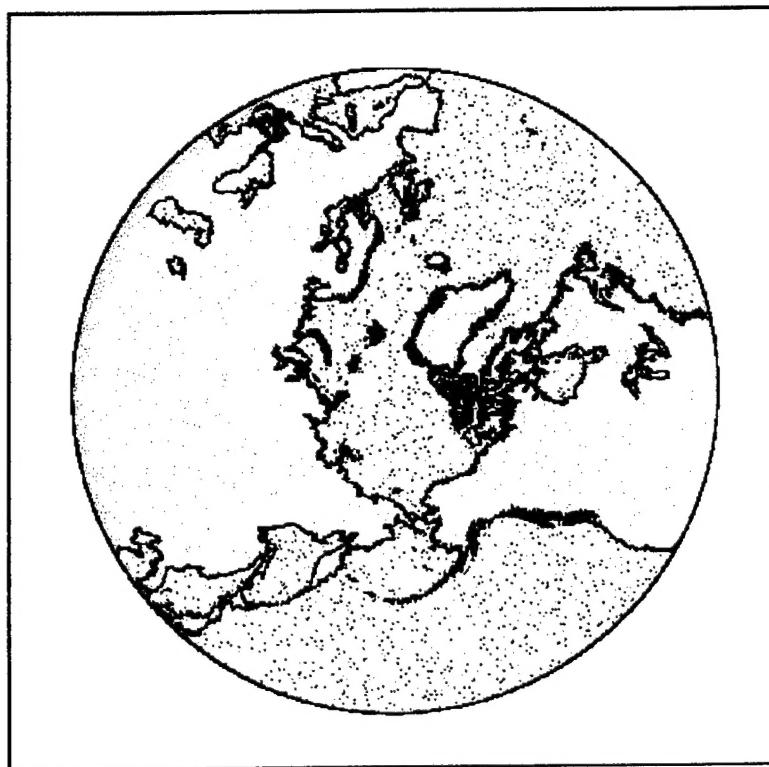
View 4 depicts the Antarctic AOI after Mapjoin, with the boundary lines still included.

- 7) Dissolve: The DISSOLVE command was used to remove the boundary lines by selecting polygons based on the attribute for land or water. After the boundary lines were removed, the land/water attributes were changed from FACC codes to a recognizable format, where l_or_w is the attribute field, and 1 or 0 for the description of the land or water.

The following illustrations show the Antarctic (View 5) and Arctic (View 6) in the final stage of the process.



View 5



View 6

3.0 Conclusion

Through the previously described process, Arc/Info® coverages were created with the Arctic AOI at 34N to 90N and 180W to 180E, and the Antarctic AOI at 50S to 90S and 180W to 180E. As a final product, each AOI exists in the Polar Stereographic projection, with the latitude of true scale of 60N for the Arctic and 60S for the Antarctic, and longitude of origin at 180W for both the Arctic and Antarctic areas. Each coverage has a perspective scale of 1:3,000,000, uses the World Geodetic System (WGS) 84 horizontal datum reference, and Mean High Water (MHW) as the vertical datum of reference. A CD-ROM (Described in Appendix A) that contains both the Arctic and Antarctic shorelines was produced for NIC's review and use in the EWG.

4.0 Acknowledgements

The Naval Research Laboratory, Code 7441 wishes to acknowledge the continued assistance and support of the National/Naval Ice Center, and Mr. David Benner and LT Kyle Dedrick and LT Sean Memmen, USN, in identifying this data requirement. Their technical support and willingness to pursue an effective GIS solution to accomplishing the EWG Sea Ice Atlas are greatly appreciated.

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5.0 Distribution:

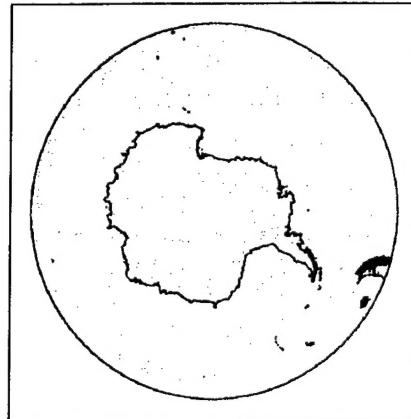
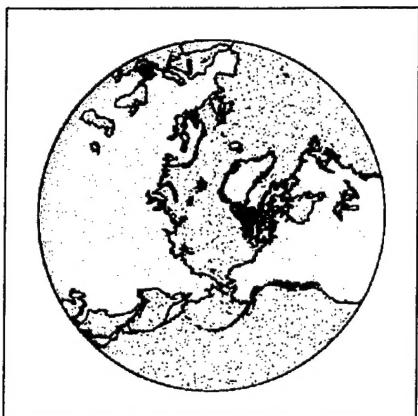
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6.0 Bibliography

¹National Imagery and Mapping Agency, 1996, "World Vector Shoreline PLUS" CD-ROM Prototype.

APPENDIX A

CDROM Request Form



The Naval Research Laboratory, NRL Code 7441, Geographic Information Systems (GIS) Lab has produced a CD-ROM of the 1:3,000,000 WVSPLUS Arctic and Antarctic regions. This data was extracted from the NIMA WVSPLUS Standard Data Product, and was clipped using the following parameters:

Projection: Polar Stereographic, North (+90) and South Pole (-90) origins, respectively.

Geographic area: Arctic Area, 90N to 34N and 180W to 180E. Antarctic Area, 90S to 50S and 180W to 180E.

Data type: Polygon with full topology

Scale: That which corresponds to the final output of the NIC ice products.

Format: ARC/INFO coverage format, also available as ArcView® Shape Files™.

Requests for this data should be made to:

Commanding Officer, Naval Research Laboratory
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Geographic Information Systems Lab
Stennis Space Center, MS 39529-5004
Attn: John Breckenridge or Martin J. Doody, III
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